Essential Python

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Demo folder: 02-PythonLang

1. Defining and Using Modules

- The Python standard library
- Understanding modules
- More about modules
- Listing the names in a module

The Python Standard Library

- Python defines an extensive and powerful standard library
  - Comprises a large number of modules
- Built-in modules are implemented in C
  - Provide access to low-level system functionality
  - E.g. file I/O
- Other modules are implemented in Python
  - See the `Lib/modules` folder in the Python installation folder
- For full info, see:
  - http://docs.python.org/3.4/library/

Understanding Modules

- You can create your own Python modules
  - Here's a simple module, which just defines some variables

```
morning = "Good morning"
afternoon = "Good afternoon"
evening = "Good evening"
```

greetings.py

- To use a module elsewhere, use the `import` keyword
  - Several ways to do this:

```
import greetings
print(greetings.morning)
```

```
from greetings import morning, afternoon
print(morning + " " + afternoon)
```

```
from greetings import *
print(morning + " " + afternoon + " " + evening)
```

More About Modules

- You can access the name of a module
  - Use the __name__ property

```
import greetings

print("Name of current module is %s" % __name__)
print("Name of greetings module is %s" % greetings.__name__)
```

usegreetings.py

- Python only imports a given module once
  - Regardless of how many times you try to import it

- Python searches the following locations for a module
  - The directory containing the input script (or the current directory)
  - The directory specified by PYTHONPATH
  - The installation-dependent default

Listing the Names in a Module

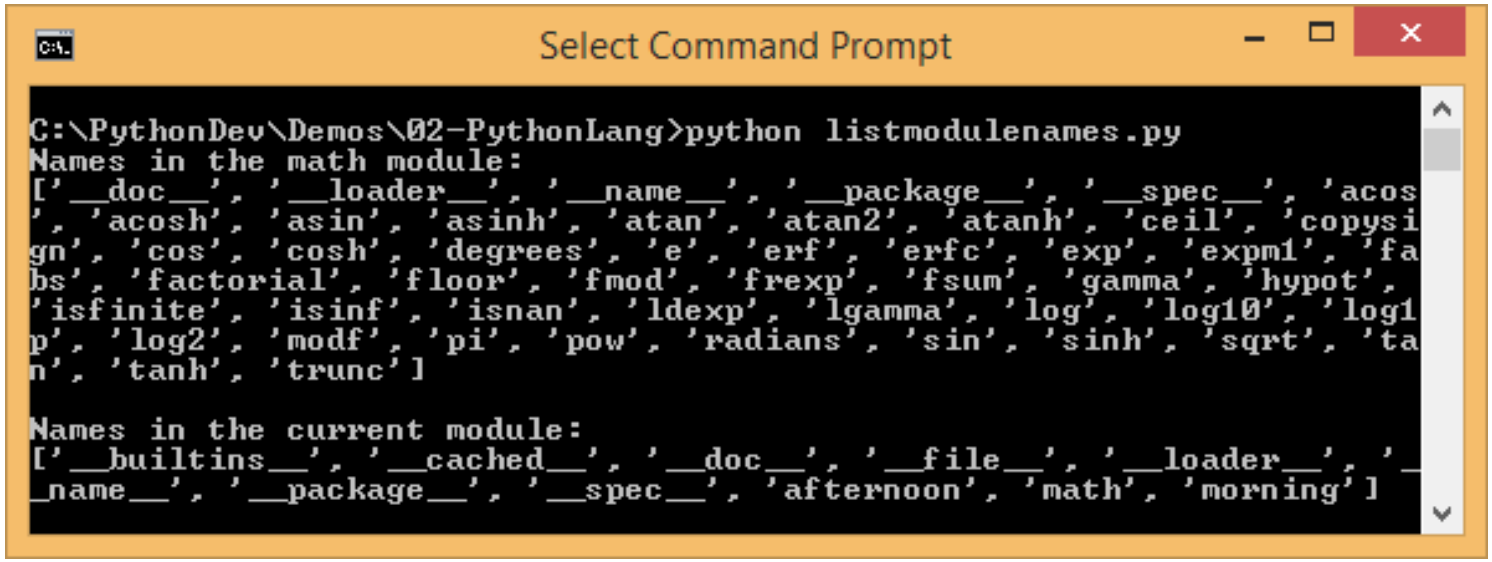
- You can list all the names defined in a module
  - Use the `dir()` built-in function

```
import math
from greetings import morning, afternoon

print("Names in the math module:")
print(dir(math))

print("\nNames in the current module:")
print(dir())
```

listmodulenames.py



2. Defining and Using Packages

- Overview of packages
- Example modules
- Importing specific modules
- Importing all modules

Overview of Packages

- Python allows you to organise related modules into packages and sub-packages
  - A package is a folder that contains a file named `__init__.py`

- Example

```
utils/                      Top-level package, named utils.
    __init__.py             Initialize the utils package.

    constants/              Sub-package for constants.
        __init__.py         Initialize the constants package.
        metric.py
        physics.py
              ...

    messages/               Sub-package for messages.
        __init__.py         Initialize the messages package.
        french.py
        norwegian.py
              ...
```

Example Modules

- Here are the modules we've defined in the `utils` package
  - Modules in the `utils.constants` sub-package:

```
INCH_TO_CM = 25.4
MILE_TO_KM = 1.61
```
metric.py

```
ELECTRONIC_CHARGE = 1.602e-19
PLANCKS_CONSTANT = 6.626e-34
```
physics.py

  - Modules in the `utils.messages` sub-package:

```
HELLO = "Bonjour"
GOODBYE = "Au revoir"
```
french.py

```
HELLO = "Hei"
GOODBYE = "Ha det bra"
```
norwegian.py

Importing Specific Modules

- To import specific module(s) from a package:

```
import utils.constants.metric

print("Inch to centimetre: %.4f" % utils.constants.metric.INCH_TO_CM)
print("Mile to kilometre:  %.4f" % utils.constants.metric.MILE_TO_KM)
```
useutils.py

- To import specific module(s) from a package, into the current symbol namespace:

```
from utils.constants import metric

print("Inch to centimetre: %.4f" % metric.INCH_TO_CM)
print("Mile to kilometre:  %.4f" % metric.MILE_TO_KM)
```
useutils.py

- To import specific name(s) from a module from a package, into the current symbol namespace:

```
from utils.constants.metric import INCH_TO_CM, MILE_TO_KM

print("Inch to centimetre: %.4f" % INCH_TO_CM)
print("Mile to kilometre:  %.4f" % MILE_TO_KM)
```
useutils.py

Importing All Modules

- You can use * to indicate you want to import all modules from a package

```
from utils.messages import *

print("Hello in French:   %s"    % utils.messages.french.HELLO)
print("Goodbye in French: %s"    % utils.messages.french.GOODBYE)
print("Hello in Norwegian:   %s" % utils.messages.norwegian.HELLO)
print("Goodbye in Norwegian: %s" % utils.messages.norwegian.GOODBYE)
```

useutils.py

- You must tell Python which modules to actually import from that package
  - In the package's `__init__.py` file …
  - Define a global variable named `__all__` and set it to a list of all the modules to be imported

```
__all__ = ["french", "norwegian"]
```

utils/messages/__init__.py

3. Built-in Types

- Numbers
- Numeric operators
- Bitwise operators
- Using the `math` module
- Booleans
- Relational operators
- Boolean logic operators
- Operator precedence
- Strings
- Other built-in types

Numbers

- Python has three numeric types
  - Integers
  - Floating point numbers
  - Complex numbers

```
i1 = 12345
i2 = 12345678901234567890
i3 = int("123", 8)
print("%d %d %d" % (i1, i2, i3))

f1 = 1.23
f2 = 4.56e-34
f3 = 7.89e+34
f4 = float("123.45")
print("%g %g %g %g" % (f1, f2, f3, f4))

c1 = 1 + 2j
c2 = 3 - 4j
c3 = 5j
c4 = complex("6+7j")
print("%g + %gi" % (c1.real, c1.imag))
print("%g + %gi" % (c2.real, c2.imag))
print("%g + %gi" % (c3.real, c3.imag))
print("%g + %gi" % (c4.real, c4.imag))
```

numbers.py

Numeric Operators

- Python supports the following operators on numbers
  - `x ** y`
  - `pow(x, y)`
  - `divmod(x, y)`
  - `c.conjugate()`
  - `complex(re, im)`
  - `float(x)`
  - `int(x)`
  - `abs(x)`
  - `+x`
  - `-x`
  - `x % y`
  - `x // y`
  - `x / y`
  - `x * y`
  - `x - y`
  - `x + y`

Bitwise Operators

- Python supports the following bitwise operators on integers
  - ~x
  - x >> n
  - x << n
  - x & y
  - x ^ y
  - x | y

Using the math Module

- The math module defines several useful mathematical constants and functions
  - For details, see http://docs.python.org/3.4/library/math.html

- Example

```
import math

print(dir(math))

print("pi is %f" % math.pi)
print("360 degrees in radians is %g" % math.radians(360))
print("2 * pi radians in degrees is %g" % math.degrees(2 * math.pi))

print("sin(90 degrees) is %.4f" % math.sin(math.pi / 2))
print("cos(90 degrees) is %.4f" % math.cos(math.pi / 2))
print("acos(0) is %g degrees" % math.degrees(math.acos(0)))

print("hypoteneuse of right-angled triangle (sides 3, 4) is %g" % math.hypot(3, 4))
print("5 factorial is %g" % math.factorial(5))
```

usemath.py

Booleans

- Python doesn't have a specific boolean data type
  - You can test any object for truth or falsehood
- The following values are considered false:
  - `None`
  - `False`
  - Zero of any numeric type, e.g. `0`, `0.0`, `0j`
  - Any empty sequence, e.g. `''`, `()`, `[]`
  - Any empty mapping, e.g. `{}`
- All other values are considered true
  - Including the `True` keyword ☺

Relational Operators

- Python supports the following relational operators
  - `<`
  - `<=`
  - `>`
  - `>=`
  - `==`
  - `!=`
  - `is`
  - `is not`

Boolean Logic Operators

- Python has thee boolean logic operators:
  - not
  - and
  - or

- Example

```
month = int(input("Enter a month number [1-12]: "))

is_summer = month >=6 and month <= 8
is_winter = month == 12 or month == 1 or month == 2
is_transition_season = not(is_winter or is_summer)

print("%s %s %s" % (is_summer, is_winter, is_transition_season))
```

booleans.py

Operator Precedence

- This table shows the precedence of all the operators in Python

Operator	Description
`lambda`	Lambda expression
`if – else`	Conditional expression
`or`	Boolean OR
`and`	Boolean AND
`not x`	Boolean NOT
`in`, `not in`, `is`, `is not`, `<`, `<=`, `>`, `>=`, `!=`, `==`	Comparisons, including membership tests and identity tests
`|`	Bitwise OR
`^`	Bitwise XOR
`&`	Bitwise AND
`<<`, `>>`	Shifts
`+`, `-`	Addition and subtraction
`*`, `/`, `//`, `%`	Multiplication, division, remainder
`+x`, `-x`, `~x`	Positive, negative, bitwise NOT
`**`	Exponentiation
`x[index]`, `x[index:index]`, `x(arguments...)`, `x.attribute`	Subscription, slicing, call, attribute reference
`(expressions...)`, `[expressions...]`, `{key: value...}`, `{expressions...}`	Binding or tuple display, list display, dictionary display, set display

Strings

- A string is an immutable sequence of Unicode characters
  - Can enclose in single quotes, double quotes, or triple quotes

```
str1 = "The computer says 'No' I'm afraid."
str2 = '<a href="www.bbc.co.uk">Click here for the BBC</a>'

str3 = """Birthday present ideas:
 - Bugatti
 - 4xHD OLED 64-inch TV
 - Socks"""

print("%s\n%s\n%s" % (str1, str2, str3))
```

strings.py

- The `String` class defines many methods
  - For details, see http://docs.python.org/3.4/library/string.html

- There's also excellent support for regular expressions
  - For details, see http://docs.python.org/3.4/library/re.html

Other Built-In Types

- Text sequence types
  - String - see previous slide
- Basic sequence types
  - List, tuple, and range
- Binary sequence types
  - `bytes`, `bytesarray`, and `memoryview`
- Set types
  - `set`, `frozenset`
- Mapping type
  - `dict`

Any Questions?